Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Bromus rubens* L. (USDA 2005)
Synonyms:	*Anisantha rubens* (L.) Nevski, *Bromus madritensis* L. ssp. *rubens* (L.) Husnot (USDA 2005)
Common names:	Red brome, foxtail chess, foxtail brome
Evaluation date (mm/dd/yy)**:**	08/06/04
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Committee review date:	08/06/04
List date:	08/06/04
Re-evaluation date(s):	

Table 2. Scores, Designations, and Documentation Levels

	Question	Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**A**	Reviewed scientific publication	**"Impact"** **Section 1 Score:** **A**	**"Plant Score"** **Overall Score:** **High** **Alert Status:** **None**
1.2	Impact on plant community	**A**	Reviewed scientific publication		
1.3	Impact on higher trophic levels	**B**	Other published material		
1.4	Impact on genetic integrity	**U**	No information		
2.1	Role of anthropogenic and natural disturbance	**A**	Reviewed scientific publication	**"Invasiveness"** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **15 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**B**	Other published material		
2.3	Recent trend in total area infested within state	**C**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**A**	Observational		
2.6	Potential for natural long-distance dispersal	**B**	Observational		
2.7	Other regions invaded	**C**	Observational		 Something you should know.
3.1	Ecological amplitude	**A**	Observational	**"Distribution"** **Section 3 Score:** **A**	
3.2	Distribution	**A**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify ecosystem processes impacted: Fire regimes, soil moisture and nutrient depletion (Alford 2002, D'Antonio and Vitousek 2002).
Rationale: Provides fine fuel to change fire frequency, intensity and rate of spread (Hunter 1991, Brooks 1999, Alford 2002) in the Sonoran, Mojave and Lower Colorado Desert (In Salo 2002). Fire impacts native desert communities especially in reducing various species of cactus and stem photosynthetic species (Alford and Brock 2002). From Simonin (2001): Red brome generally shortens fire return intervals (McClaran and Brady 1994, McPherson and Muller 1969, Zedler et al. 1983). Increased presence of red brome has promoted fires in areas where fire was previously infrequent due to insufficient fuels (Phillips 1992). Once established red brome may increase fire frequency by enhancing potential for start and spread (Beatley 1966). In general, red brome produces an abundant and continuous cover of persistent fine fuels, promoting fast, "hot" fires (Brooks 1999). Red brome produces high amounts of persistent flammable fuels in perennial plant interspaces, promoting ignition and spread (Brown and Smith 2000). Within the Sonoran Desert, dead and dry brome is easily ignited, supporting fast-moving surface fires (Phillips 1992). In Salo (2002): *Bromus rubens* has higher nitrogen uptake rates, relative to native western USA species (Hunter 1991, Brooks 1998, Padgett and Allen 1999).
Sources of information: See cited literature.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify type of impact or alteration: Competition with native species for soil moisture and soil nutrients. Can displace native plants especially in areas with repeated disturbance or as a result of fire in a fire-intolerant system (clear links between invasion by red brome and damage to fire-intolerant perennials Brook 1999).
Rationale: In the Sonoran Desert, fire return intervals are shortened, changing the vegetational composition through increase of non-native components and loss of native plant species (Rogers and Steele 1980 in Simonin 2001). From Simonin (2001): Since 1976, increased winter ppt has promoted the spread of red brome. In relatively dry areas of the Southwest, red brome may displace native species during wetter years (Banner 1992, Biswell 1974, Hunter 1991). Species will out-compete other grass/shrub species for available surface soil moisture and nutrients, especially nitrogen (Allen et al 2001). Dense stands utilize winter moisture (Wu and Jain 1979) and uptake soil nutrients (D'Antonio and Vitousek 2002). In stands of *B. rubens* competition for water, nutrients, and light, decreases the survivability of a plant (Hufstader 1976 in Newman 1992, Wu and Jain 1979). Density and biomass of native annual species (Mojave Desert) were significantly greater when red brome density was reduced, indicating that this grass may reduce the growth of native annuals (Brooks 2000 in Salo 2002). However, Salo (2002) found red brome did not exclude native Sonoran Desert winter annuals from emergence nor survival; however, there was clear evidence of reduced growth of Sonoran Desert winter annuals occurring with red brome. Red brome is an example of species with a positive fire grass cycle (D'Antonio and Vitousek 2002) which can alter the physiognomy of southwestern communities, killing fire intolerant native succulents and woody species (Salo 2002). Other authors note that the shallow root system of red brome limits its ability to search for nutrients (Newman 1992). Impact of the shallow fibrous root system more prevalent

in a wet year versus a dry year. Years of above-average winter precipitation red brome can dominate annual communities in the Sonoran (P. Anning, personal communication, 1998 in Salo 2002) and Mojave Deserts (Brooks 1998). Cohorts of red brome emerge in episodes related to late summer, autumn and early winter precipitation events (M. Acton and J. Brock, personal observations, 2004).
Sources of information: See cited literature and personal observations by J. Brock (Professor, Applied Biological Science, Arizona State University, Tempe, 2004) and M. Acton (Graduate Researcher, Arizona State University, Tempe, 2004).

Question 1.3 Impact on higher trophic levels *Score:* **B** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: Reduces diversity of food types and tends to convert desert shrub/perennial grass communities to annual grasslands especially with fire (Beatley 1966, Turkowski 1975 in Simonin 2001). Dominance of red brome grass essentially creates a monoculture on more of a micro-scale than landscape scale (Alford and Brock 2002). Seed awns of many *Bromus* species are harmful to large mammals (Humphrey 1950 in Simonin 2000).
Rationale: Changes in community that can occur following fire, from desert shrub/perennial grass communities to annual exotic grasslands also influences the density (positively and negatively) of wildlife and insects (Newman 1992). Less variety of forage for animals, especially affects small mammals due to seed production and shoot/seedling herbivory of native plants (Turkowski 1975 in Simonin 2001). Small mammal populations may decrease through loss of food items. Little forage value to livestock and big game (Simonin 2001). Krausman and others observed light use by desert mule deer (Krausman et al. 1997). Desert cottontails prefer red brome, especially during the winter (Turkowski 1975 in Simonin 2001).
Sources of information: See cited literature.

Question 1.4 Impact on genetic integrity *Score:* **U** *Doc'n Level:* **No info.**
Identify impacts: Unknown
Rationale: Hybridization is not known (K. Steele, personal communication, 2004). There are studies of hybridization among perennial *Bromus* species (Ferdinandez and Coulman 2001). However, *Bromus arizonicus*, a native annual *Bromus,* overlaps in range with red brome (USDA 2005 and B. Phillips, personal communication, 2004).
Sources of information: See cited literature and personal communications by B. Phillips (Zone Botanist, U.S. Department of Agriculture, Forest Service, Coconino, Kaibab, and Prescott National Forests, 2004) and K. Steele (Associate Professor, Arizona State University East, Applied Biological Science, Mesa, 2004).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Describe role of disturbance: Can established with or without disturbance.
Rationale: Disturbance of natural vegetation and bare surface soils are prime candidates for red brome invasion (Beatley 1966, Hunter 1991). "Invades even relatively undisturbed areas of the Sonoran (Burgess et al. 1991), Mojave (Beatley 1966, Hunter 1991), and Great Basin Deserts (Tausch et al. 1994)" (Salo 2002). These disturbances are often initially human caused, but red brome can also establish without human disturbance from natural perturbations like droughts and floods (K. Watters, personal communication, 2004). Invades denuded lands (Mojave Desert) (Piemeisel 1932 in Burgess et al 1991), disturbed sites (Hitchcock et al. 1969) and undisturbed landscapes (Beatley 1966). Tends to colonize waste sites, roadsides, disturbed areas, heavily grazed areas, perimeters of nuclear test sites (Hunter 1991). Humans tend to bare soil surfaces, opening niches for invasive plant establishment. Red brome also appears in areas of very low disturbance (Hunter 1991).

In Simonin (2001): Red brome establishes from on- and off- site seed sources following fire (O'Leary and Westman 1988). In the Sonoran Desert, red brome showed dramatic increases following a prescribed burn in a desert scrub of paloverde, bursage and cholla (Loftin 1987). Within the Mojave Desert of AZ, red brome prefers disturbed sites, especially areas where shrubs have been removed by fire; readily invaded blackbush communities susceptible to fire (Beatley 1966).
Sources of information: See cited literature and personal communication by K. Watters (Research Technician, Southern Colorado Plateau Network, National Park Service, Flagstaff, Arizona 2004).

Question 2.2 Local rate of spread with no management *Score:* **B** *Doc'n Level:* **Other Pub**.
Describe rate of spread: Increasing, but less rapidly.
Rationale: All habitats in the hot desert, shrublands and desert grasslands of Arizona (below Mogollan Rim) contain this species (J. Brock, personal observation, 2004). Rate of spread is cyclical, dependent upon the wet-dry cycles of the Sonoran Desert ecosystem. Ruyle and Young (1997 in Guertin and Halvorson 2003) report that this grass is still spreading within Arizona's borders. From Simonin (2001): Betancout (1996) attributes red brome expansion in the upper Sonoran Desert of central and southern Arizona to climate change. Since 1976 increased winter ppt has promoted the spread of red brome. In relatively dry areas of the Southwest, red brome may displace native species during wetter years (Banner 1992, Biswell 1974, Hunter 1991).
Sources of information: Score based on personal observations by J. Brock (Professor, Applied Biological Science, Arizona State University, Tempe, 2004) and Working Group discussion; also see cited literature.

Question 2.3 Recent trend in total area infested within state *Score:* **C** *Doc'n Level:* **Obs.**
Describe trend: Stable
Rationale: Appears to have established in all niches within the state (J. Brock, personal observation, 2004 and Working Group consensus). Comments from Salo (2002) "although the rate spread has slowed since 1942, it appears to have moved into new regions during this time, including northern and south-central Utah, northeastern Arizona, southwestern New Mexico and northwestern Sonora, Mexico. May have reached its ecological limits (Wu and Jain 1979).
Sources of information: Score based on personal observations by J. Brock (Professor, Applied Biological Science, Arizona State University, Tempe, 2004) and Working Group discussion; also see cited literature.

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Other Pub.**
Describe key reproductive characteristics: Flowers in winter, begins seed dispersal in late spring. Reproduces by seed only.
Rationale: Annual seed production high in wet winters, and especially high in years following 2 wet winters (Wu and Jain 1979). In Guertin and Halvorson (2003): Red brome produces an average of 76 seeds per plant, measured in natural populations and calculated 83,699 seeds/m^2 are produced in a plot of densely spaced plants (Wu and Jain 1979). Can germinate in fall, winter, and spring (Newman 1992). Can survive long periods of drought (Beatley 1966). No reproductive info in the Fire Effects Information System (Simonin 2001).
Sources of information: See cited literature.

Question 2.5 Potential for human-caused dispersal	*Score:* **A** *Doc'n Level:* **Obs.**
Identify dispersal mechanisms: Penetrates human clothing, vehicle tire treads and parts of off road vehicles. Can be contaminant of hay and cereal crops.	
Rationale: Barbed awns readily attach to susceptible surfaces (Hitchcock 1971). Harvested native grasses could contain seeds of red brome.	
Sources of information: Score based on Working Group consensus; also see cited literature.	

Question 2.6 Potential for natural long-distance dispersal	*Score:* **B** *Doc'n Level:* **Obs.**
Identify dispersal mechanisms: Occurs at an infrequent rate. Attaches to hairs and fur of animals. Potential for seedheads/seeds to be transported by wind, water, and animal movement (Guertin and Halvorson 2003).	
Rationale: Barbed awns readily attach to susceptible surfaces (Hitchcock 1971). Slightly winged nature of caryopsis allows for some buoyancy in wind. Wind helps red bromes' short distance dispersal, along with man aiding in its long-distance dispersal (Brooks 2000).	
Sources of information: Score based on Working Group consensus; also see cited literature.	

Question 2.7 Other regions invaded	*Score:* **C** *Doc'n Level:* **Obs.**
Identify other regions: Hot deserts and chaparral of California, hot deserts of Nevada and Mexico and chaparral in Mexico. Occurs in deserts of Oregon and Washington and, based on Gould (1975), the Trans-Pecos region of west Texas.	
Rationale: Inference based on literature and personal observations.	
Sources of information: See cited literature; also see Kearney and Peebles (1960) and (Hitchcock 1971). Also considered personal observations by J. Brock (Professor, Applied Biological Science, Arizona State University, Tempe, 2004)	

Question 3.1 Ecological amplitude	*Score:* **A** *Doc'n Level:* **Obs.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: Assumed to have been introduced to AZ by Spanish colonizers sometime after 1530 (Tellman 1997), and continual reintroduction from California, Nevada (Hunter 1991, Beatley 1966) and Mexico by human commerce. From Guertin and Halvorson (2003): Germination occurs in cooler, moister seasons, usually after heavy rains through the winter and into spring (Beatley 1966). Hammouda and Bakr (1969) report that optimum conditions for germination of *Bromus rubens*' seeds are temperatures between 68 to 77°F (20 to 25°C) during the deliverance of rainfall greater than 0.4 in. (1.0 cm). *Bromus rubens* grows well on shallow soils (Sampson et al. 1951 in Winkler 1987, Thornburg 1982 in Winkler 1987) with optimum soil depth 0-10 in. (0 to 25 cm). It grows in sandy, sandy loam, and loam soils with some tolerance for saline soils (Dittberner and Olson 1983 in Winkler 1987), although it prefers and grows optimally in silty to mid-clay soils (Thornburg 1982 in Winkler 1987). It prefers gentle to moderate slopes, and grows poorly on steep slopes (Dittberger and Olson 1983 in Winkler 1987). It prefers soils with a minimum pH of 6.0 and a maximum pH of 8.2 (USDA 2005). The species' success in desert areas may also be attributed to its high tolerance to salt and to high pH in soils (Newman 1992). Earliest record in SEINet as of 11/10/04 was 1926, collected along the Verde River. Lots of records began showing up in the 1930s.	
Rationale: Over 300 records in Arizona herbariums. See also Worksheet B of this document.	
Sources of information: See cited literature. Also considered information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed 2004) individual Working Group member observations.	

Question 3.2 Distribution *Score:* **A** *Doc'n Level:* **Obs.**
Describe distribution: Continuous distribution within hot deserts and areas with Mediterranean climates of the southwest. Most commonly found within canopy zone of woody perennials like mesquite during less favorable years of rainfall (J. Brock, personal observation, 2004).
Rationale: Over 300 records in Arizona herbariums (SEINet 2004). See also Worksheet B of this document.
Sources of information: SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed 2004). Also considered personal observations by J. Brock (Professor, Applied Biological Science, Arizona State University, Tempe, 2004).

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	$\boxed{\text{Yes}}$	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	$\boxed{\text{Yes}}$	**No**	**2 pt.**
Populations of this species produce seeds every year.	$\boxed{\text{Yes}}$	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	$\boxed{\text{Yes}}$	**No**	**1 pt.**
Seeds remain viable in soil for three or more years	**Yes**	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	$\boxed{\text{No}}$	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**Yes**	$\boxed{\text{No}}$	**1 pt.**
Fragments easily and fragments can become established elsewhere	**Yes**	$\boxed{\text{No}}$	**2 pt.**
Resprouts readily when cut, grazed, or burned	$\boxed{\text{Yes}}$	**No**	**1 pt.**
	Total pts: 6 Total unknowns: 1		
	Score : A		

Note any related traits:

Worksheet B. Arizona Ecological Types
(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	
Scrublands	Great Basin montane scrub	**C**
	southwestern interior chaparral scrub	**C**
Desertlands	Great Basin desertscrub	**A**
	Mohave desertscrub	**A**
	Chihuahuan desertscrub	**B**
	Sonoran desertscrub	**A**
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	**B**
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	**A**
	southwestern interior riparian	**A**
	montane riparian	
Woodlands	Great Basin conifer woodland	**D**
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

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